EasyChair Preprint

№ 8230

Design and Development Intelligent Medical Care Bed Using Voice Recognition

Moeid Elsokah and Amer Zerek

June 10, 2022

Design and development Intelligent Medical Care Bed Using Voice Recognition

Moeid M Elsokah [1], Amer R. Zerek[2]

[1] *College of Electronic Technology, Communication Engineering Department*
Tripoli, Libya
E- mail moayedmohamedm@gmail.com

[2]*Zawia University, Faculty of Engineering/ EE Department,*
Zawia, – Libya,
E-mail anas_94az@yahoo.co.uk

Abstract - Recently, with the development of technology in the medical and industrial fields, which contributed to the arrival of this technology to smart homes and life-saving hospitals for people to stay in their homes in a comfortable place where the normal situation for their lives, independence and freedom, and maintaining their security and health,. Message Sheet offers a specially designed medical care bed for patients in homes, nursing homes, hospitals or other people who need some special treatment and any form of health care by voice command. To control the smart bed system with the use of sensors capable of transmitting voice-activated signals, Numerous settings and capabilities are accessible via voice commands, including changeable height for the full bed, head and foot, and customizable temperature. Medical beds for patients and the elderly are now available. If the patient has a disorder that makes it impossible for them to live independently at home, this device allows them to be self-sufficient and does not require the assistance of others as in the past. It's all part of keeping up with research and development by incorporating smart technology into hospital beds to improve comfortability and limit the frequency of preventable diseases like pressure ulcers, which can occur when people stay in bed for lengthy periods of time. It is a network of electronic, mechanical, and digital components that are all working together.

Keywords- Smart Bed System, Sensor , Actuators, Smart Technology, Air Mattress.

I INTRODUCTION

Since the discovery of the stethoscope two hundred years ago, the diagnosis of diseases has taken a different dimension than it was before, and since then medicine has developed an amazing development, as have other sciences thanks to technology, and the hypothetical diagnostic role of the doctor has atrophied in favor of machines that visualize, examine, analyze, test and put the results in front of the doctor who prescribes medicine After he is fluent in reading and analyzing reports. Improving Health Information Technology to help promote and expand health information technology adoption, Congress passed the HITECH Act as part of the American Recovery and Reinvestment Act of 2009. A key part of the HITECH Act was establishing a purposeful use clause, which requires electronic health records to allow the electronic exchange of health information and the provision of clinical information. The purpose of HITECH is to ensure that electronic information is shared with other patients and physicians securely. HITECH also aims to help healthcare providers perform more efficient operations and reduce medical errors. The number of seniors in Canada is increasing at a rapid rate, seniors with the total estimated to reach around 10 million by 2036. The New Horizons Program for Older Persons (NHSPs) [1] aims to empower and encourage older people to share their shills, knowledge, and experience with others in society, as well as to help older people's social well-being and community vitality. [1] Improving care and efficiency, Technological development has helped provide safer and more reliable patient care. Developing programs for disease control: Researchers have been able to develop specific programs, through which diseases, their causes and symptoms are classified within a huge database, which helps to track the actions necessary to control the disease and provide appropriate care. Housing costs vary according to the level of service and care required. the Canadian Mortgage and Housing Corporation's (CMHC) Housing articles contain information about the cost of housing for seniors in the county or territory. [2] Prevention and treatment of chronic diseases: Technological development has helped to preserve the health of patients and manage their chronic conditions better than it was before, as customized technologies have been developed that help in monitoring and stimulating such conditions and regular communication with patients.

II RELATED WORK

In 1979, [3] concluded that the medical and nursing needs of elderly patients admitted to acute medical wards were studied.

The number of elderly patients being admitted to hospitals is on the rise. and all potential alternatives to hospital care must be taken into account.According to [4] most health care systems around the world have a serious problem with excessive use of acute beds. Therefore, it is not surprising that a great deal of effort has been invested in trying to determine how many patients are inappropriately admitted or how many days they spend in acute beds. [5] Investigated the design of safety elements in medical bed side rails and thus establish certain design rules for assessing and designing according to actual patient needs. Referring to [5] the choice to utilize medical metal bed side rails should be decided after a complete assessment of the patient's needs, a safe bed environment can be provided for a patient. In 2016 [6], conducted a study with the purpose of presenting the various aspects of modern high-complexity electric beds from 1940 to 2000. The chronology of the product has been strictly divided into three big stages: electric and semi electric beds (until the 90's), mechatronic beds (90's until 2000) and, mechatronic intelligent beds of the last 15 years. In 2018, [6] said that this topic of research is crucial in light of global ageing and is being fuelled by an increase in accessible options. In 2019 [7] described the design and simulation of side rail strength and latch reliability tests for Medical Beds (MBs) using fluidSIM. The test system has been designed to meet the requirements of IEC 60601-2-52. In 2019 [9] presented a checklist to verify the usability of the pushbutton panels that control their movements, which might be useful in building a controller capable of taking into account the demands of users such as caregivers and patients. In 2020, [10] depicted that a COVID-19 is one of the most dangerous pandemics in the last century, with its rapid global spread overwhelming hospitals and communities in Italy and around the world, an examination of hospital capacity and efficiency in the administration of its structures prior to the emergency breakout is an important starting point for further investigation of how the situation was managed. [11] Concluded that International statistics on the number of medical group beds is difficult to collect in this subject.This analysis uses data from the World Health Organization (WHO) (2020a) on the number of accessible medical group beds in 37 (mostly European) countries in 2009. Based on the forecasted increase in deaths, demand of medical beds in England is likely to increase by 39% over the next 40 years. [11]

III METHODOLOGY

In this thesis, a smart medical bed was designed that can control its movement conditions by voice commands, encourage its manufacture locally and reduce costs, and it can be used in homes, hospitals or care centres and support global expansion and export it to the world, a significant reduction in price that everyone can own after Study materials on the market and provide services in Health care for a large part of the patients. The elderly and people with special needs. Inspect the frame, support, frame and base to ensure safety. One of the main objectives in this thesis was to design a reliable local smart bed by realizing the following purposes.

1. Analysing all component and material smart bed products on the market for a local with costs in mind in the design.
2. Analysing the accuracy of the smart bed in its ability to respond to voice commands and implement them to provide patterns and loss of movement.
3. Analysis of the accuracy of the smart bed in response and sensitivity in measuring the heart rate of the user.
4. To provide the possibility of changing the smart bed patterns through voice commands.

A. Anthropometric Data

Anthropometric data is the standard ratio for me to determine the dimensions, length, and width based on a case study of the community. Random samples are taken and arithmetic mean is found for them to know the standard sizes. Anthropometric data must be taken into account for the achievement of this smart bed to determine the bed dimensionsin terms of design, size, height, and length, as well as taking into account the joints of the human body. To provide a reasonable level of comfort for the patient in this bed. Fig. 1 below contains anthropometric statistics that are all connected with the height of a person.

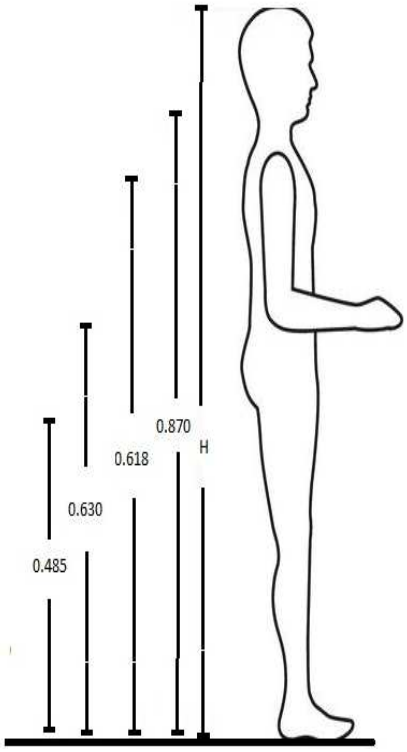

Fig 1: Anthropometric data

This anthropometric chart shows a seated state for the measurements used in the smart bed motion command application. Fig. 2 shows an anthropometric data set. To learn about the lengths employed in the iron and wooden frames, as well as the locations where linear motors are fixed.

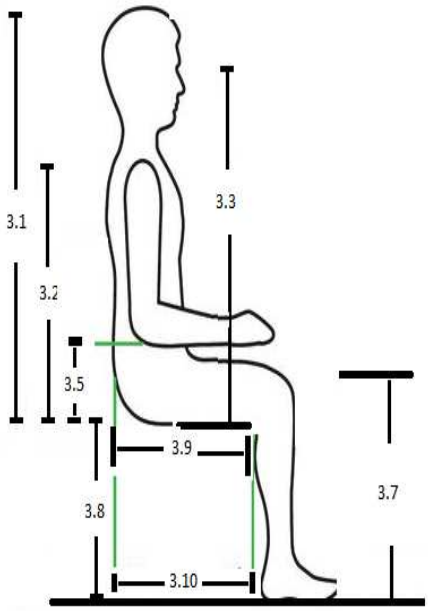

Fig 2: Anthropometric Data showing various human proportions

B. Bed frame

The wooden structure of the bed was designed and supported, the linear actuator, bases and sensors were installed, the structure tested and the bed bearing the maximum weight of 150 kg. The following figures 3,4 shows the structure of the bed and the final design. Fig.s 3, 4 below clearly illustrates the separation of the front and side views of the bed's structure

Fig 3: The Split Bed Structure side view

Fig 4: The Split Bed Structure front view

C. Bed Positions and movements

1. The height of the head and back area is higher at an angle of (0-85) degrees.
2. The movement position changed from the section bottom of the feet to the down from (0-30) degrees.
3. The angle of inclination of the entire bed towards the head.
4. The angle of inclination of the entire bed towards the feet.

D. National Standards

Table 1 shows the manufacturing industry's recommendations for the proper height and width of human length by gender and country. The parameters listed in Table 1 below describe the design specifications that were created and followed.

TABLE1: Curatorial Industry Standards of Hospital Beds that have been applied

	Maximum Value	**Minimum Value**
Bed length	200 cm	190 cm
Bed Width	100 cm	90 cm
Weight Capacity	Appro 100 KG	230 KG

IV. HARDWARE

Hardware Requirements:
Arduino UNO, Easy VR Shield 2.0, Relay, Sensors, Linear actuator, Jumper cable, Voltage source.

Program Requirements:

• To program and control the microcontroller, the built-in C language is used to control the actuators at the same time and fetch data from the sensors.

• To train the recorded voice commands, the access port and UNO are used.

V. RECEIVING AND EXECUTING VOICE COMMANDS

The idea of a smart bed was connected to the electronic circuit, according to the design, with the Arduino Uno, all sensors, linear actuators, and the audio pickup that receives voice commands and is responsible for responding to the required frequencies according to the required order and implementing them. Connect the Arduino board to the voice recognition circuit EasyVR 2.0 . board Speech recognition that can distinguish different sounds and commands. As a result of EasyVR's capability to It's compatible with Arduino boards and runs on 3.3V to 5V, which is a low-power voltage range. It is possible to have as many different languages as needed and available for each function, for example in English or American or Italian or Japanese or German or Spanish. Files up to 32 players (supported) as well as commands in any language are also supported by EasyVR. Arduino UNO with EasyVR 2.0 are shown in Fig. 5 below.

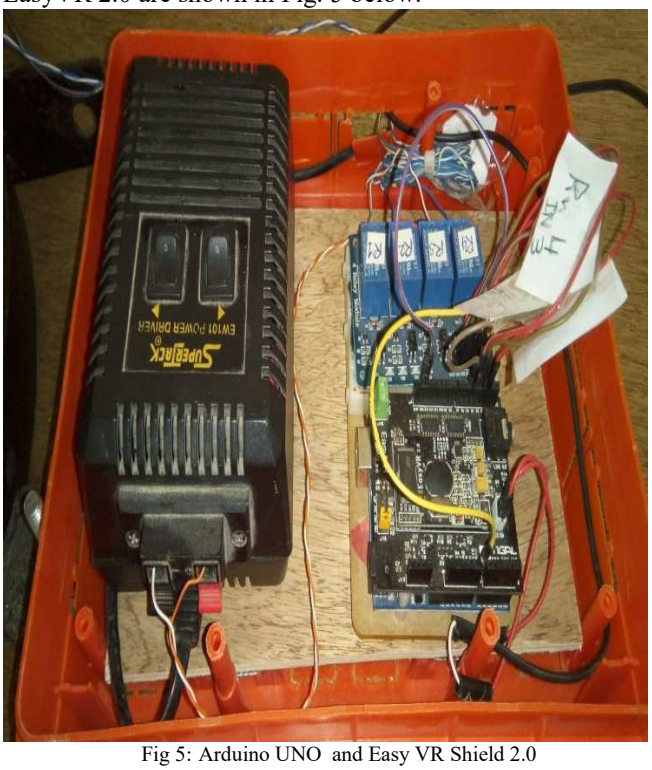

Fig 5: Arduino UNO and Easy VR Shield 2.0

VI. BLOCK DIAGRAM ELECTRONIC SYSTEM COMPONENT

The graphic shows the communication between the electronic system and the sensors in Fig. 6. The voice command given by the user is received via a microphone to the Esay VR 2.0 voice recognition chip, and the command is transmitted to the Arduino board to carry out the required command, such as raising the back level, so the Arduino gives a command by means of a pulse to change the state The relay responsible for raising the back level to the (NO) position. The Arduino also receives the temperature and humidity data from the DH11 sensor and the heart rate sensor data from the analog ports, and this data is analysed and displayed.

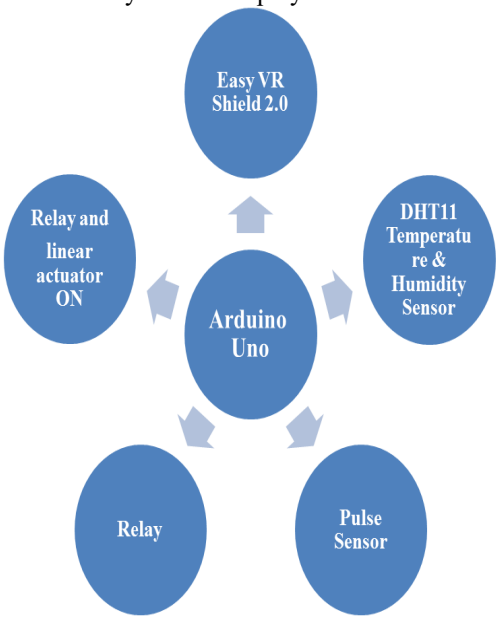

Fig 6 : Communication between the electronic system and the sensors

VII. FLOWCHART EXECUTING VOICE COMMANDS

Flowchart is a type of diagram that shows how the process goes from start to finish. The process appears from the beginning and the password is entered and the system response begins to the voice commands that change the movement modes of the smart bed and the basis of movement by motors for linear movement connected by relays that are responsible for opening and closing the circuits according to the order to be accomplished and these commands are arranged in the following scheme in shapes such as boxes and other Fig.s with connectivity. The following Fig. shows voice commands, receiving, responding, and executing them.

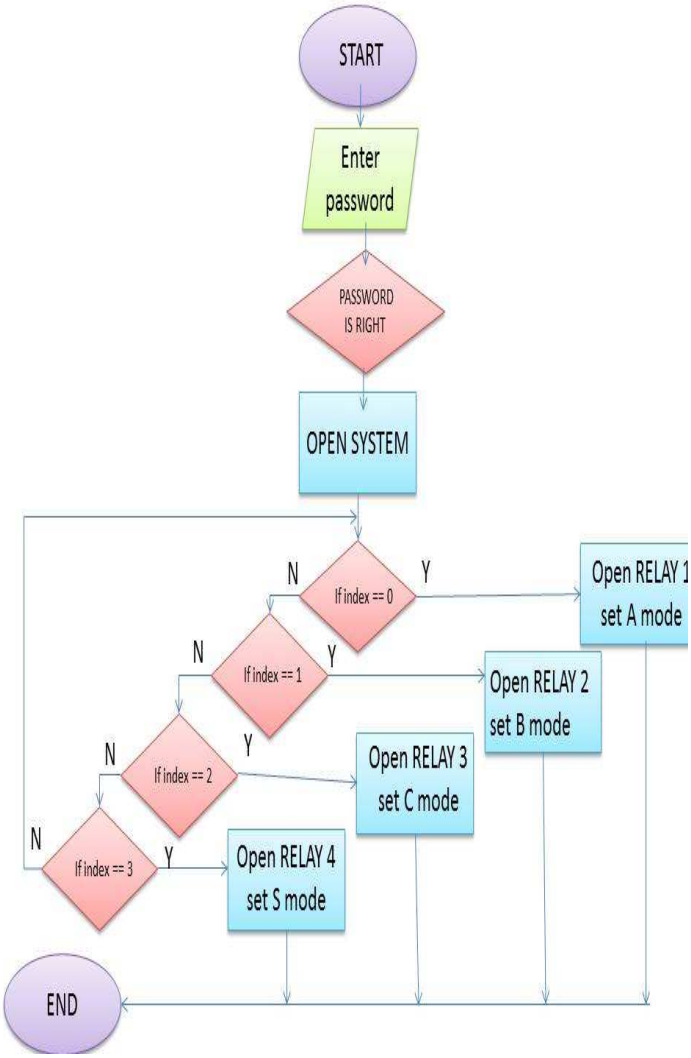

Fig 7 : Flowchart to receive voice commands

VIII. RESULTS IN VOICE RECOGNITION

Voice commands are applied to the movement modes and the results are analyzed from the command response, the repetition of the command and other movements performed by the smart bed, and the calculation of the arithmetic average for responding to voice commands. Iteration is done to calculate the percentage of each movement pattern and a different mode change for it. Fig. 6 shows the response rate to voice commands for males and females of various ages. After testing and calculations and finding the arithmetic mean, voice commands achieved success in addition to the speed of response to them with different ages and genders of males and females, which represented 97%. Accuracy of total requests. The result of the implementation of voice commands and the speed of response to them is very good, accurately distinguishing between the sounds of different frequencies with good efficiency. Fig. 7 below shows the recognition success rate for various ages of males and females.

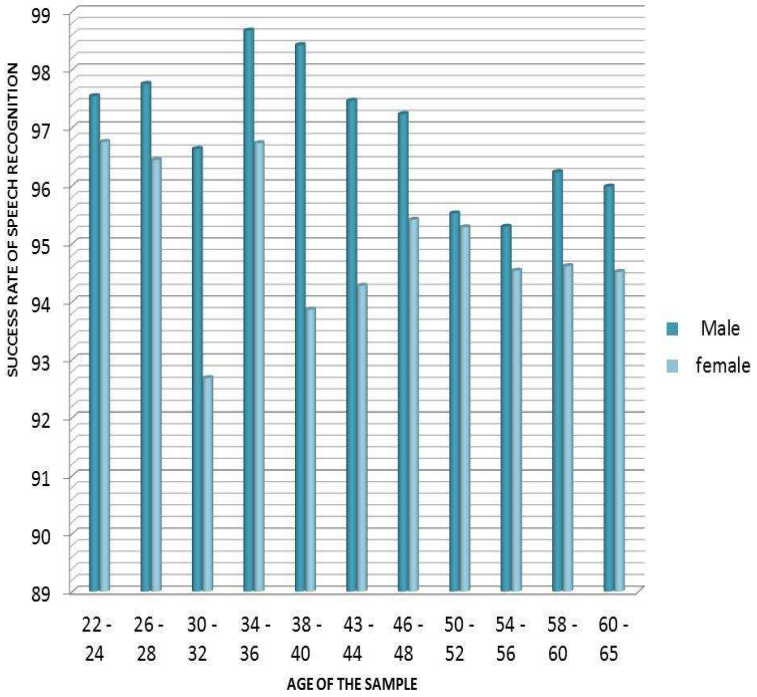

Fig 8 : success rate of recognition for the different ages of men and women.

IX. RESULTS IN DHT SENSOR

The reading for the DHT sensor was RH [5 %] humidity accuracy and Celsius [2 %] temperature accuracy. The results were recorded at the time of the test, the temperature was 22 degrees and the humidity was [56 %] , and the following Fig. shows the measurement of heat and humidity. Fig. 9 below shows reading for the DHT sensor.

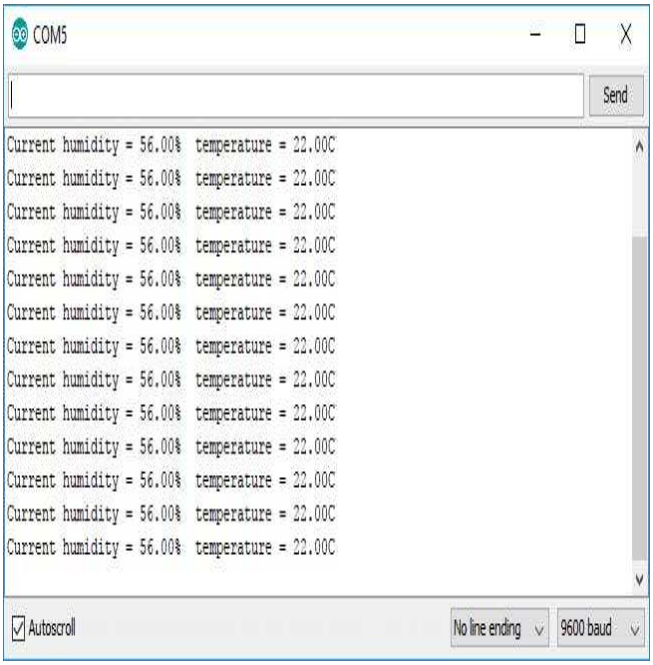

Fig 9 : Reading for the DHT sensor

X. RESULTS IN PULSE SENSOR

The results of the response to the sensor in measuring the heart rate at the time of the test were (68) beats per minute. It was noted that the sensor needs a little time to give a clearer and more accurate reading. The following Fig. shows the results of the test to measure the heartbeat. Fig. 10 below shows response pluse sensor.

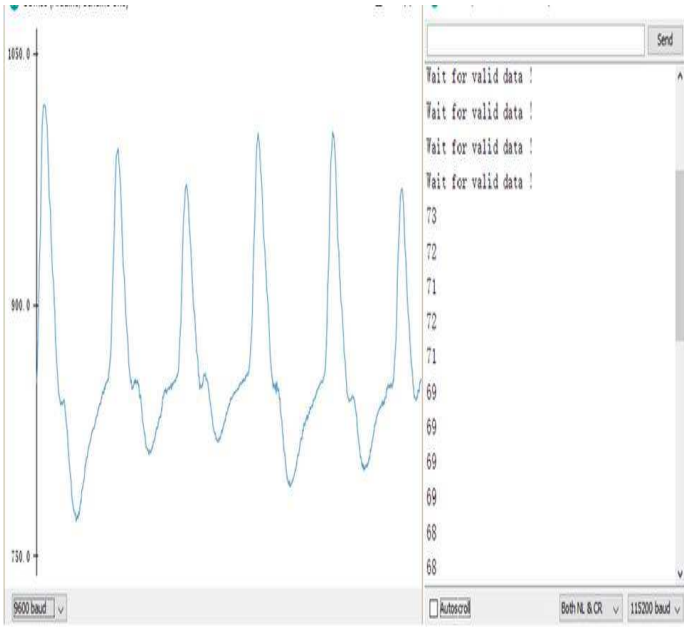

Fig 10 : response pluse sensor

XI. CONCLUSION

The smart bed in this work was designed using studies, research, parallel markets, and materials available in the local market. This bed benefits patients and people with special needs, as well as medical personnel and carers who suffer from spinal and back injuries. Thanks to technological development, the best results were obtained. For a variety of reasons, hospital beds are medically important, such as for posture, in order to alleviate pain and prevent infections, sores, and respiratory problems. Avoiding respiratory infections and ulcers Preventing convulsions or the need to raise the head of the bed due to congestive heart failure and chronic aspiration Lung disease, heavy lifting that nurses usually do leads to problems in the back and spine, With the help of the smart bed, patients, the elderly, and others with special needs can live more independently in their own homes. Every day, those with special needs require the support of their loved ones. When people are confined to their homes, they are more likely to recover faster and stay healthy longer. One of the biggest challenges facing systems that rely on recognition Of the voice in case of illness and weak voice or sick, and in the case of crowded place and a lot of noise It will be difficult for the system to distinguish and know the commands and their implementation. The smart medical bed responds to me by voice commands of the smart bed's motion mode pattern, sensing room temperature and humidity, as well as measuring heart rate and blood pressure Supporting patient independence. Helping nurses get rid of back and spine diseases, reduce costs, and support local production with good quality and competitive prices.

REFERENCES

[1] Public Health Agency of Canada . Available in :https://www.canada.ca/en/employment-social development/programs/new-horizons-seniors.html, Jul 13-14 ,2022 1:00 PM.

[2] Public Health Agency of Canada , Housing options for seniors ,Available in :https://www.canada.ca/en/financial-consumer-agency/services/retirement-planning/cost-seniors-housing.html ,Aug 16,2022 6:30 PM.

[3] COLIN T. CURRIE, ROGER G. SMITH, J. WILLIAMSON, "MEDICAL AND NURSING NEEDS OF ELDERLY PATIENTS ADMITTED TO ACUTE MEDICAL BEDS" , Volume 8, Issue 3, Pages 149–151, doi.org/10.1093/ageing/8.3.149, August 1979.

[4] Marian, S.McDonagh, David H.Smith, MariaGoddard, "Measuring appropriate use of acute beds: A systematic review of methods and results" , elsevier journal, Health Policy 53 (2000) 157–184.

[5] Mohammad Abdullah, Taha Almandrawy , "Safety design of side rails for metal medical beds", doi. 10.21608/IDJ.2015.101970, Volume 5, Issue 1 - Serial Number 13, Winter 2015, Page 183-189, 2015.

[6] I Ghersi, M Mariño , M T Miralles , "From Modern Push-Button Hospital-beds to 20th Century Mechatronic Beds: A Review" , Journal of Physics: Conference Series, Volume 705, 20th Argentinean Bioengineering Society Congress, doi:10.1088/1742-6596/705/1/012054, 28–30 October 2015.

[7] Ignacio Ghersi, Mario Mariño, Mónica Teresita Miralles, "Smart medical beds in patient-care environments of the twenty-first century: a state-of-art survey" , BMC Medical Informatics and Decision Making volume 18, 2018.

[8] Sutrisno Salomo Hutagalung, Imamul Muchlis, Khusnul Khotimah, Siddiq Wahyu Hidayat, on "Design and Simulation of Side Rail Strength and Latch Reliability for Medical Beds Testing Using FluidSim", 2019 International Seminar on Research of Information Technology and Intelligent Systems (ISRITI), IEEE, DOI: 10.1109/ISRITI48646.2019.9034564, Yogyakarta, Indonesia ,5-6 Dec, 2019.

[9] Davide Bacchin , Patrik Pluchino, Valeria Orso, Marcello Sardena, Marino Malvestio, Luciano Gamberini , "Development and Testing of a Usability Checklist for the Evaluation of Control Interfaces of Electrical Medical Beds" , International Conference on Human-Computer Interaction, vol 12778, Electronic ISSN 1611-3349, 2019.

[10] Fabrizio Pecoraro ,Fabrizio Clemente,Daniela Luzi , "The efficiency in the ordinary hospital bed management in Italy: An in-depth analysis of intensive care unit in the areas affected by COVID-19 before the outbreak" , PLOS ONE, doi.org/10.1371/journal.pone.0239249,Sep, 2020.

[11] Rodney P Jones, "How many medical beds does a country need? An international perspective", British Journal of Healthcare Management , doi.org/10.12968/bjhc.2020.0028, Vol. 26, No. 9, 2020.

.